Fundamental Research to Better Ensure Computational Correctness and Data Integrity

"Silent Data Corruption (SDC) occurs when incorrect data is delivered by a computing system to the user without any error being logged" - *Cristian Constantinescu, AMD*

Microprocessor-based systems are a common design for high performance computing (HPC) platforms. When used for computation, a fault in any of the microprocessors could cause a crash or silent data corruption (SDC). Radiation-induced failure modes caused by neutrons have been observed in HPC hardware. This work presents results from an accelerated neutron test of hardware used in Roadrunner, the first Petaflop supercomputer.

Replicates of two microprocessors, the IBM PowerXCell 8i and the AMD Opteron 2210 HE, along with the hardware in their respective beampaths were tested at LANSCE for neutron sensitivities.

- Both microprocessor beampaths were found to be susceptible to radiation-induced failures and SDC.
- The SDC cross-section was 72 times larger for the Opteron beampath than the Cell beampath and the Opteron beampath failure cross-section was almost an order of magnitude larger than that for the Cell beampath. In both cases, it is possible that these results reflect a difference in architecture complexity.
- The data provided some evidence for process variation-based radiation sensitivity differences.
- Little application-based dependence in radiation sensitivity was found, with hybrid Linpack most likely to lead to a somewhat elevated hazard rate.
  (Experimental results presented at NSREC)

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